

interior. *Western North Carolina and northern Georgia*,  $\frac{1}{2}$  inch. *Tennessee*, none to 2 inches. *Ohio valley*, 2 to 24 inches. *Lower Lakes*, 4 inches to 2 or 3 feet at eastern ends of Lakes Erie and Ontario. *Upper Lakes*, 1 to 2 inches near Lake Superior to 2 or 3 $\frac{1}{2}$  feet along eastern shore of Lake Michigan. *Northwest*, generally from 1 to 6 inches, except from Arkansas to Illinois, where it was much deeper, some observers reporting 2 and 3 feet. *Rocky Mountain stations*, 1 $\frac{1}{2}$  inch at Santa Fé to 7 $\frac{1}{2}$  at Denver and 4 at Virginia City. *Black Hills*, Deadwood, 18 inches.

## RELATIVE HUMIDITY.

The average percentage of relative humidity for the month ranges as follows: New England, 65 to 79; Middle Atlantic States, 62 to 78; South Atlantic States, 65 to 72; East Gulf States, 72 to 79; West Gulf States, 61 to 81; Lower Lakes, 71 to 84; Upper Lakes, 66 to 83; Ohio valley and Tennessee, 65 to 76; Upper Mississippi valley, 70 to 76; Lower Missouri valley, 70 to 85; Red River of the North valley, 84 to 94; Eastern Slope, 61 to 77; Western Plateau, 46 to 59; California, 44 to 59. *High stations* report the following; not corrected for altitude: Cheyenne, 66; Denver, 51; Colorado Springs, 63; Santa Fe, 49.

## WINDS.

The prevailing winds at the Signal Corps stations are shown by arrows on chart No. II. From an examination of which, it will be seen that they have been almost, without exception, from the north or northwest, except in the Lake region, Ohio valley and Atlantic States, where they have been more westerly, and in some instances southwest.

*Total Movements of the Air.*—The following are the *largest* monthly movements recorded at the Signal Corps Stations, viz: Cape May, 16,567 miles; Wood's Holl, 15,969; Sandy Hook, 15,426; Cape Lookout, 14,227; Thatcher's Island, 13,584; Indianola, 12,428; Barnegat, 11,046; Cape Henry, 10,564; Sandusky, 10,426; Newport, 10,396; Key West, 9,917; Milwaukee, 9,858. The *smallest* are: Visalia, Cal., 1,443 miles; Deadwood, Dak., 1,658; Nashville, 2,853; Salt Lake City, 2,895; Santa Fe, 2,941; Lynchburg, 2,969; Indianapolis, 3,246; Augusta, 3,526; Knoxville, 3,730; Dubuque, 3,565; Eagle Pass, Tex., 3,620; Los Angeles, 3,906.

## VERIFICATIONS.

*Indications.*—The detailed comparison of the tri-daily weather Indications with the telegraphic reports for the succeeding twenty-four hours, show the general percentage of omissions to be 1.4 per cent., and of verifications to be 87.1 per cent. The percentage of verifications for the four elements have been: weather, 93.6; wind, 84.4; temperature, 86.5; barometer, 83.8. The percentage of verifications by geographical districts have been: New England, 88.6; Middle States, 87.0; South Atlantic States, 85.5; East Gulf States, 90.1; West Gulf States, 88.6; Lower Lake Region, 87.1; Upper Lake Region, 88.4; Tennessee and the Ohio Valley, 85.5; Upper Mississippi Valley, 85.2; Lower Missouri Valley, 84.6. Of the 3,667 predictions that have been made, 118 or 3.2 per cent. are considered to have entirely failed; 141 or 3.8 per cent. were one-fourth verified; 361 or 9.8 per cent. were one-half verified; 281 or 7.7 per cent. were three-fourths verified; 2,766 or 75.5 per cent. were fully verified, so far as can be judged from the tri-daily weather maps.

*Cautionary Signals.*—During the month 187 Cautionary Signals were displayed; 155 or 82.9 per cent. were justified by subsequent hourly velocities of 25 miles or over at, or within 100 miles of, the station.

*Cautionary Off-shore Signals.*—50 signals, not included in the above, were ordered up as Cautionary Off-shore Signals; 36, or 72.0 per cent., of these were justified, both as to velocity and direction. 78 Cautionary Signals were changed to Cautionary Off-shore Signals, and, as to direction, 67 or 85.9 per cent. were justified; as to velocity they are considered with the cautionary. 68 cases were reported, generally from scattered stations, of winds of 25 miles or over where signals were not ordered.

## NAVIGATION.

In the table, on right side of chart No. III, are given the highest and lowest readings, on the Signal Corps river-gauges, during the month, with dates of same.

*Ice on Rivers and Lakes.*—*Missouri*—Fort Randall, Dak., 24th, river closed by ice; Yankton, 13th, closed by ice; Omaha, 18th, closed by ice; Croning, 18th, closed by ice; Leavenworth, 11th to 14th, much floating ice,—17th, gorge formed one mile below,—18th, frozen over; Lexington, 23rd, closed; Booneville, 27th, closed. *Mississippi*—St. Paul, 14th, frozen over; La Crosse, 7th, first floating ice,—11th, ice gorged,—12th, river closed; Dubuque, 2nd, last boat of season left, latest closing of navigation since 1857,—7th, full of floating ice,—17th ice-gorge,—18th, frozen over,—23rd, teams crossing; Fulton, 9th, ice stopped running; Le Claire, 14th, frozen over, people crossing; Davenport, 7th, first floating ice,—14th shore ice,—18th, navigation closed,—20th, frozen over,—26th, teams crossing; Muscatine, 8th, floating ice, 19th, closed,—23rd, teams crossing; Burlington, 9th, first ice in river,—10th to 13th, floating,—13th, navigation entirely suspended,—16th, frozen over; Ft. Madison, 18th, river closed; Keokuk, 7th, much floating and shore ice,—10th, canal closed,—20th, ice 8 to 10 inches thick,—27th to 31st, floating and shore ice; St. Louis, 15th to 23rd, floating ice,—17th, navigation suspended,—24th, gorged and frozen over, people crossing; Cairo, 23rd to 31st, river frozen. *Maquoketa*—Monticello,

Iowa, 20th, frozen over. *Des Moines*—Boonsboro', 19th, frozen over. *Spring River*—Empire City, Kans., 18th, closed with ice,—31st, ice 14 inches thick, "hardest frozen ever known." *Rock River*—Rockford, Ills., 7th, 8th and 18th, frozen over,—13th and 15th, partly frozen; Sterling, 6th and 7th, frozen over. *Ohio*—Pittsburgh, 25th, both rivers frozen over. Cincinnati, 19th, canal frozen over; 20th, ice four inches thick; 24th, river full of floating ice, impeding navigation; 25th to 31st, all southern packets laid up, ferries stopped. Louisville, 25th, canal frozen; 26th, navigation closed; 30th, river full of floating ice. Cairo, 25th to 31st, floating ice. *Licking River*—Cincinnati, 23d, frozen over; 30th, ice 8 inches thick. *Monongahela*—Morgantown, 26th, river frozen  $\frac{1}{2}$  inch thick; 27th, ice two in. thick; 28th to 31st, ice 3 in. thick. Pittsburgh, 23d, floating ice; 25th, frozen over. *Alleghany*—Pittsburgh, 19th and 21st, floating ice; 25th, frozen over. *New River*—Wytheville, Va., 25th, river and Barret's mill dam frozen over. *James River*—Dover Mines, Va., 27th and 28th, frozen over; 29th, ice moving; 26th to 31st, canal frozen and navigation suspended. *Potomac*—Washington, 26th and 28th, river frozen. *Susquehanna*—*North Branch*—Catawissa, 25th, frozen over; navigation closed on the 11th, owing to damages caused by high water. *Delaware*—Trenton, 8th, canal frozen over, first time this season; 14th, river frozen over. Philadelphia, 19th, ice forming; 20th to 25th, floating ice. *Hudson*—Albany, 11th, floating ice, 23rd, frozen over, navigation closed; Ardenia, 27th, navigation closed; West Point, 25th, frozen over; Wappinger's Falls, 24th, floating ice, 28th, navigation closed, 31st, ice 9 inches thick. New York, 26th, much floating ice in rivers. *Long Island Sound*—Flushing Creek, 23rd, navigation closed, 27th, ice 6 inches thick. *Thames River*—New London, 27th, frozen over. *Penobscot River*—Bangor, Me., 7th, ice forming, 8th, frozen over. *Lake Superior*—Duluth, 23rd, ice in inner harbor  $\frac{1}{2}$  inch thick, lake free during rest of month; Ashland, 15th, Long Island bay closed by ice; Marquette, 20th and 29th, ice in harbor. *Lake Michigan*—Escanaba, 16th, ice around docks, 29th, bay frozen over; Embarrass, Wis., 1st, rivers closed; Manitowoc, 7th, rivers closed; Chicago, 16th, navigation closed, 24th, river frozen over, people crossing. *Monono Lake*, Wisconsin.—7th, bay frozen over, 16th, lake frozen over. *Mendota Lake*, Wisconsin.—22nd, frozen over, 31st, ice 16 to 25 inches thick. *Geneva Lake*, Wisconsin.—26th, frozen over, horses and ice-boats on ice. *Lake Huron*—Port Huron, 15th, navigation closed, 24th, ice-floes in St. Clair river. *Lake Erie*—Toledo, 20th, river frozen over; Sandusky, 14th, ice along docks, 18th, bay entirely frozen over; Cleveland, 15th, navigation closed, 16th, first ice in river, 17th, first ice on lake, 18th, canal frozen over, 20th, river frozen over. Buffalo, 7th, navigation closed, 28th, lake frozen as far as visible with glass. *Niagara River*—Ft. Niagara, 24th to 31st, river half to nearly full of floating ice. *Lake Ontario*—Rochester, 1st, lake navigation closed; 7th, navigation closed on Erie canal; Oswego, 1st, navigation closed; Madison Barracks, 27th, bay frozen over. *Otsego Lake*, N. Y.—31st, partially frozen over. *Lake Massabesic*, N. H.—17th, frozen over. *Lake Winnepiseogee*, N. H.—27th, closed by ice. *Cape Lookout*, N. C.—28th, sound frozen nearly half a mile out. *Cape May*—24th, ice in Egg Harbor.

*High Tides*.—Coney Island, 10th, bathing-houses, &c., washed away; Eastport, Me., 23rd, tides very high, overflowing wharves; Newport, R. I., 23rd, unusually high, overflowing wharves in some parts of the city; Wappingers Falls, N. Y., 2nd, 10th to 12th.

*Low Tide*.—Cape Lookout, N. C., 26th, lowest known tide in sound for fourteen years.

## TEMPERATURE OF WATER.

The temperatures of water, as observed in rivers and harbors, with average depth of observations, is given on Chart No. III. At the following stations, observations were discontinued on account of ice, on the dates named: December 15th, at Buffalo; 16th, Escanaba; 18th, Chicago and Cleveland; 19th, Marquette; 20th, Toledo; 22nd, Grand Haven and Detroit; 24th, Sandusky. Observations were resumed at Marquette on the 25th and continued until the 28th; they were interrupted at Cleveland on the 2nd, 4th, 5th, 7th and 10th to 12th by rough water.

## ATMOSPHERIC ELECTRICITY.

*Thunder-storms*.—Gulf Hammock, Fla., 24th, Independence, Kan., 7th; Brookhaven, Miss., 9th; Weldon, N. C., 10th; Aiken, S. C., 26th; Melissa, Tex., 7th; Red Bluff, Cal., 6th; Smithville, N. C., 26th; Cape Lookout, N. C., 2nd.

*Auroras*.—Bangor, Me., 1st; Boston, 1st; Eastport, Me., 1st, 26th; Pembina, Dak., 23rd, 24th; Cornish, Me., 24th; Gardiner, Me., 16th; Orono, Me., 15th, 16th; Cambridge, Mass., 16th, 19th, 23rd; Fall River, Mass., 16th; Dunbarton, N. H., 19th; Contoocookville, N. H., 16th; Freehold, N. J., 24th; Atco, N. J., 25th; Jacksonburg, Ohio, 27th; Cincinnati, 3rd; North Lewisburg, Ohio., 13th; Brownsville, Pa., 11th to 14th; Woodstock, Vt., 16th; Embarrass, Wis., 1st; Yankton, Dak., 1st; Starkey, N. Y., 16th.

## OPTICAL PHENOMENA.

*Solar Halos*.—1st, Md., N. J., N. Y., Pa. 2d, Nev. 4th, Tex. 6th, Cal., Neb., Kan. 7th, Ill., Ia., Ohio, Tenn. 8th, Cal., Tex., Conn., N. J., N. Y. 9th, Me., Cal. 71th, Tex., Ohio, Nev. 12th, Ia., Neb. 13th, Ind., Ohio. 14th, Ia., Ga., S. C. 16th, Fla., Kan., Ohio, Vt., Nev. 17th, Minn., Fla., Col., Mass., Mo., Neb. 18th, Dak., Kan., Mo., N. H. 19th, Ia., N. Y., Ohio. 20th, Ia., Kan. 21st, Ia., Ohio, Dak. 22d, Ia., Dak. 23d, Ia., Fla., Dak., Kan., Me., Neb., W. Va., Nev. 24th, Ia., Vt., Dak., Kan., Neb. 25th, Ill., Ia., Dak., Kan., Ohio. 26th, Ia., N. Y. 27th, Ia., Ohio. 28th, Ill., Ia., Wis. 29th, R. I., Mass., N. H., N. Y. 30th, Dak., Va. 31st, Ia.